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(71)(72) Applicant and Inventor: CONNER, Stephen, Joseph, Charles [GB/GB]; 9 Winton Drive, Glasgow G12 0PZ (GB).

(74) Agent: BUTLER, Michael, John; Frank B. Dehn & Co., 179 Queen Victoria Street, London EC4V 4EL (GB).

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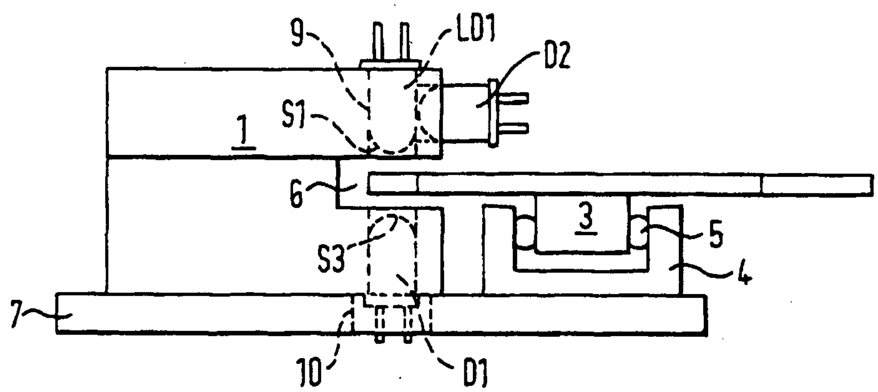

(57) Abstract

An optical potentiometer comprises a base (7), a longitudinally extending support (4) provided on the base, a slider (2) mounted on the support for longitudinal movement, a control member (16) on an outer lateral edge of the slider, the inner lateral edge (13) of the slider being solid and tapering in the longitudinal direction, a light source (LD1) on one side of the slider adjacent the inner lateral edge, and light detecting means (D1) aligned with the light source and on the other side of the slider, so that longitudinal movement of the slider under the action of the control member selectively controls the amount of light reaching the light detecting means from the light source. Optionally second light detecting means (D2) is positioned on the one side of the slider to receive light from the light source (LD1) without the intervention of the slider (2), and compensating means are provided to control the output of the light source in accordance with a signal from the second light detecting means, using negative feedback.

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OPTICAL POTENTIOMETER

This invention relates to an optical potentiometer, in which movement of a control member is used to vary electric voltage or current. Such potentiometers may be used to control light or audio output, for example.

A conventional type of potentiometer consists of a movable electrical contact which bears upon a resistive element. When such a potentiometer is subject to repetitive displacement, the resistive element and / or the movable element can be damaged by wear. This may be aggravated by dirt or other foreign bodies entering the potentiometer. A relatively small amount of wear or contamination can lead to erratic performance and this may render the potentiometer unusable. Potentiometers, frequently operated by a sliding control member, are often used to control lights or audio output in discotheques and similar situations, where they can be subject to very heavy use with rapid adjustments being made. This leads to rapid wear.

In United States Patent 3,859,617 there is disclosed a contactless, optical potentiometer. A light source and a photoconductive cell are separated by a rotatable disc which is provided with a slot which is aligned with the light source and the photoconductive cell. The cross section of the slot increases along an arc so that as the disc is rotated the amount of light reaching the photoconductive cell may be varied. In this manner the resistance of the cell may altered in accordance with the rotational position of the disc. However, rotationally controlled potentiometers are not optimal for all uses, and particularly the control of light and audio in discotheques and similar situations as mentioned above.

In United States Patent 4,523,090 there is disclosed a linear optical potentiometer. A light

emitting diode and a photodiode sensor are mounted at opposite ends of a housing but are not in direct alignment, being vertically offset so that the sensor can be exposed only to part of a cone of light from the light source. A linear control member has a light blocking portion which moves longitudinally towards and away from the sensor, and as it does so it progressively obstructs more or less of the cone of light being emitted by the diode which can reach the sensor. However, the design requires considerable separation of the light source and sensor and lends itself to limited design variations. The light blocking portion simply moves between a position in which the sensor is fully blocked, and one where it is not. To vary the rate of adjustment requires increasing or reducing the distance between the light source and sensor and that requires constructing a new potentiometer with different dimensions.

United States Patent 4,796,000 discloses, in one embodiment, a linearly controlled optical potentiometer. Once again there are disclosed a light source and a light sensor at opposite ends of an elongate housing, and in this case they are laterally offset so as to be either side of a film separating them. This film has varying light transmitting characteristics along its length. A pair of movable reflectors are positioned one each side of the film, and are connected to a longitudinally movable slide control. Light from the source passes to one reflector, is rotated through a right angle, is then passed through the film to the other reflector, is rotated through a right angle again, and then passes to the sensor. The position of the slide control and reflectors determines which part of the film the light passes through, and thus how much light is transmitted. This is a complex arrangement.

According to one aspect of the present invention there is provided an optical potentiometer comprising a

light source, a light detecting means, a linearly movable control member, and light blocking means disposed between the light source and light detecting means which is movable to selectively determine the amount of light from the source which is received by the light detecting means, the position of the light blocking means being controlled by the linearly movable control member, characterised in that the light blocking means moves transversely with respect to the path of light from the light source to the light detecting means and has an operative edge which is profiled to adjust the amount of light passing from the light source to the light detecting means in accordance with the transverse position of the light blocking means.

This provides a simple and effective arrangement for a linearly controlled optical potentiometer. The operative edge may be a confined edge defined by a slot. For example there could be a triangular or other shaped slot in a solid plate serving as the light blocking means. Preferably, however, the operative edge is a free edge of the light blocking means. In the preferred embodiment there is a single operative edge, although it would be possible to have a pair of edges. Such a pair of edges would normally meet, notionally or in fact, at a point on a transverse line which passes through the central axis of the light path from the source to the detecting means so that the light is blocked and unblocked on two sides simultaneously. Thus, the light blocking means could take the form of e.g. a solid plate with an isosceles triangular aperture with both long sides being operative; or a plate which is in the form of an isosceles triangle with both long sides being operative. In the preferred embodiment there is a plate with a single edge and the light blocking means progressively blocks or unblocks the light from one side only.

The operative edge may be of any desired profile to

provide the desired effect. In a simple arrangement it will be purely linear with a constant angle with respect to the direction of movement. However, there could be changes in angle or the profile could be curved, at least in part. Changing the profile of the edge of the light blocking means is a simple way of designing the potentiometer to have different characteristics.

In a preferred form of an optical potentiometer according to the invention, there is provided a base, a longitudinally extending support provided on the base, a slider mounted on the support for longitudinal movement, a control member on an outer lateral edge of the slider, the inner lateral edge of the slider being opaque and tapering in the longitudinal direction, a light source on one side of the slider adjacent the inner lateral edge and light detecting means aligned with the light source and on the other side of the slider, so that longitudinal movement of the slider under the action of the control member selectively controls the amount of light reaching the light detecting means from the light source.

Preferably the light source, light detecting means and light blocking means are within a light proof housing, to prevent interference from extraneous light.

In a practical arrangement the output of the light detecting means of an optical potentiometer in accordance with the invention will be fed to signal processing means where its output can be converted to a form suitable for whatever application the potentiometer is to be used in, such as one or more voltages or currents. For example, the output could be used to control audio signals. In one embodiment it could be processed to achieve cross fading between two mono or stereo audio signals. This could be achieved using two or more voltage controlled amplifiers. Non-linear amplifiers may be used to provide a desired variation of audio volume in accordance with the position of a

slider. The potentiometer may be part of an audio mixing unit, for example of the type used by disc jockeys in discotheques, producers in broadcast or recording studios, and other similar situations.

The light source in a preferred embodiment is a light emitting diode, and the light detecting means may for example be a silicon photodiode or a phototransistor. One problem with light sources such as light emitting diodes is that there may be fluctuations in output, for example as a result of temperature variations. This would cause unwanted variations in signal level. To compensate for this, in a preferred embodiment of the present invention there is provided second light detecting means which samples the output of the light source and adjusts the output by means of negative feedback so as to maintain it substantially constant. Preferably the second light detecting means is identical to the first light detecting means so as to ensure that there will not be variations through differential fluctuations of the characteristics of the light detecting means.

The compensation arrangement will be of use in various types of optical potentiometer, and thus viewed from another aspect the present invention provides an optical potentiometer comprising a light source, first light detecting means, a movable control member, and light blocking means disposed between the light source and the first light detecting means which selectively determines the amount of light from the source which is received by the first light detecting means in accordance with the position of the movable control member, characterised in that there is provided second light detecting means arranged to detect light from the light source without the intervention of the light blocking means, and compensating means which maintains the output of the light source substantially stable in accordance with a signal provided by the second light

detecting means.

Such an arrangement can be used with a slider controlled potentiometer as discussed earlier or with a rotary control. In such an arrangement the light blocking means could be in the form of a rotatable plate with a tapering slot.

A preferred embodiment of the present invention will now be described by way of example only, with reference to the accompanying drawings in which:

Figure 1 is a side elevation view of an optical potentiometer unit in accordance with the invention;

Figure 2 is a plan view of the optical potentiometer unit;

Figure 3 illustrates the operation of the optical potentiometer showing the output from the optical photodiode with the photo resistant interruptor in a series of positions;

Figure 4 is a block diagram showing the use of feedback from the compensating photodiode D2 to control the output from the light emitting diode;

Figure 5 is a circuit diagram of the optical potentiometer; and

Figure 6 is a graph showing the simulated transfer characteristic of the processing circuit.

As shown in Figure 1 the optical potentiometer comprises a light emitting diode LD1, a photodiode D1, a compensating photodiode D2 located in an optical mounting bracket 1, and a photo resistant interruptor 2 mounted on a movable table 3 comprising a frame 4 and a linear bearing 5.

A spacer channel 6 of constant section is formed parallel to base plate 7 in surface 8 of the optical mounting bracket 1. A secondary channel 9, formed in the optical mounting bracket 1 perpendicular to the base plate 7 intersects the spacer channel 6. A light emitting diode LD1 is mounted at the upper end of channel 9 with the light emitting surface S1 oriented

towards the spacer channel 6. A channel 10, corresponding to channel 9, is formed in the base plate 7 to facilitate the mounting of photodiode D1 at the lower end of channel 9 with the photoreceptive surface S3 oriented towards spacer channel 6.

A channel 11 is formed perpendicular to, and opening onto, channel 9 to facilitate the mounting of compensating photodiode D2 with the photoreceptive surface S2 oriented towards the light emitting surface S1 of the LED LD1. The sensing and compensating photodiodes D1 and D2 are both of exactly the same type to ensure consistant operation of the optical potentiometer regardless of factors, such as temperature or aging, which may alter performance.

The linear bearing frame 4 is fixed to the base plate 7. The movable table 3 is attached to frame 4 by means of a linear bearing 5, as known in the art. The motion of table 3 is contained within a single axis 12 parallel to both the surface 8 of the optical mounting bracket 1 and the base plate 7. The photo resistive interruptor 2, as shown in Figure 2, is in the form of an opaque plate and is provided on its outer edge with an operating control 16 so that it may be moved by hand. On its inner edge it is formed as an interrupting edge 13 which is oriented at an angle to an axis of motion 12 of the movable table 3. The interruptor 2 is fixed to the upper surface of the movable table 3 such that interrupting edge 13 is positioned between the light emitting surface S1 and the photoreceptive surface S3 of the LED LD1 and photodiode D1, respectively.

In operation the interruptor 2 is moved in either direction along the axis 12, as shown in Figs. 3a-c, and the position of the interrupting edge 13 relative to the LED LD1 and photodiode D1 varies accordingly so as to cover the emitting surface S1 of the LED LD1 to a degree dependent on its position. This affects the amount of light falling upon the photodiode D1. The regulating

means operate by using the photodiode D2 to sample the light output directly from the LED LD1. The photo-current due to the direct light is compared with a reference current and the error compensated by means of negative feedback, using a high-gain operational amplifier U1A.

As shown in Figure 3a, when the interruptor is positioned to permit the maximum amount of light to pass from the LED LD1 to the photodiode D1 the current passing across the photodiode is also at maximum. Conversely when the interruptor is positioned to permit the minimum amount of light to pass from the LED LD1 to the photodiode D1, as shown in Figure 3c, the current across the photodiode is at a minimum. Figure 3b shows an intermediate position. The current across the photodiode is generally proportional to the position of the interruptor.

A block diagram illustrating the operation of the compensating circuit is shown in Figure 4. The current through the compensating photodiode D2 increases as the amount of light falling on it increases. This change in current is used as negative feedback to the operational amplifier which compares the feedback value to a reference level and amplifies the difference. The inverting configuration of the operational amplifier U1A causes a drop in the output current to the emitter follower reducing the light emitted from the LED LD1. If the amount of light falling on the compensating photodiode D2 is reduced there is a corresponding increase in the output current supplied to the emitter follower and the light emitted from the LED LD1 increases. Thus, the light emitted from the LED LD1 is maintained at a constant level.

The circuit diagram for the present embodiment is shown in Figure 5. The operational amplifier U1A is in an inverting configuration with the compensating photodiode D2 connected in parallel across the input

terminals. A transistor Q1 supplies current to the LED LD1; the base is connected to the output of the operational amplifier U1A; the emitter is connected to the LED LD1; and the collector is connected to the supply voltage. The light from the LED LD1 is sampled by the compensating photodiode D2 and this establishes the negative feedback loop. A resistor R16 is connected to the negative input of the operational amplifier U1A and stabilises the output from the operational amplifier U1A, and consequently the LED LD1, at a non-zero operating point. When the circuit is in balance all the photocurrent from D2 flows in the resistor R16. The values shown give a nominal LED current of 20mA at V_{EE}=-12V.

An operational amplifier U2A is in an inverting configuration with the sensing photodiode D1 connected in parallel across the input terminals. The input into the operational amplifier U2A is determined by the amount of light falling on the sensing photodiode D1. As the amount of light falling on the sensing photodiode D1 increases the current input into the amplifier also increases. The inverted configuration of the amplifier provides for a drop in output if the current input into the negative terminal increases and, conversely, the output increases if the input decreases. A trim circuit 14 comprises a resistor R12 and variable resistor VR1 connected in series with the power supply VEE; this is also connected to the negative input of the operational amplifier U2A and allows the output from the operational amplifier U2A to be adjusted to zero when the photo resistant interruptor 2 is in the middle of its travel range.

The output from the operational amplifier U2A is connected to the resistor R1 and capacitor C3, which are connected in parallel, and used as negative feedback. The resistor R1 converts the current output from the amplifier U2A to the required voltage; the capacitor C3

removes interference which would otherwise result at high frequencies. Both of the operational amplifiers U1A and U2A must be FET input, for example TL07X.

An operational amplifier U2B and a resistor R3 are connected, in parallel, to the output from the operational amplifier U2A. In this configuration the operational amplifier U2B acts as a signal invertor for the output from the operational amplifier U2A. The inverted signal is then connected in series with a resistor R7 and the positive terminal of an operational amplifier U2D.

The operational amplifier U2D and the resistor R7 are connected, in series, to the inverted output (via the inverting operational amplifier U2B) from the operational amplifier U2A. Similarly, the operational amplifier U2C and a resistor R6 are connected, in series, to the direct output from the operational amplifier U2A. The negative inputs to the operational amplifiers U2C and U2D are connected, in parallel, to a trim circuit 15 and resistors R9 and R8, respectively. The trim circuit 15 comprises a resistor R14 and variable resistor VR2 connected in series with the power supply VEE; this allows the output from the operational amplifiers U2C and U2D to be adjusted to zero when the photo resistant interruptor 2 is at the end of its travel range.

The amplifiers U2C and U2D use identical inverted processing stages to shape the outputs from the amplifiers U2A and U2B to the required output form. The output from the operational amplifier U2C is connected to resistor R4 and a Zener diode D3, which are connected in parallel, and used as negative feedback. The output from the operational amplifier U2D is connected to resistor R5 and a Zener diode D4, which are connected in parallel, and used as negative feedback. The Zener diodes limit the output voltages to around 6V, and -0.7V.

The simulated transfer characteristic of the processing circuit is shown in Figure 6. Line A represents the output voltage from the operational amplifier U2A as the amount of light projected on it decreases from the maximum to minimum levels. The output voltage from the inverting operational amplifier U2B is represented by Line B. The corresponding output voltages from circuit outputs CV1 and CV2 are represented by Lines C and D, respectively. The measured outputs vary slightly from the simulated results but this is due to discrepancies in the Zener diode model.

Prior to use of the optical potentiometer it may be necessary to first calibrate the unit using trim circuits 14 and 15. To avoid interference with the optics, this procedure should be carried out in subdued light. A signal source is connected to the output channel CV1 and the interruptor is moved to one end of its travel range; the output signal should disappear just before the interruptor reaches the end. If the signal fades too soon, or not at all, then the variable resistor VR2 in the trim circuit 15 should be adjusted. The process should then be repeated for the other output channel CV2 with the interruptor positioned at the other end of its travel range; the variable resistor VR1 in the trim circuit 60 should be adjusted if the output is non-zero. This process should be repeated until both channels fade out completely without excessive 'dead zone' at the ends of travel. The process should not need to be repeated after the initial calibration. If the optical potentiometers were produced in a suitably reliable manner it would not be necessary to calibrate each unit prior to use.

All of the resistors in the circuit are 1% metal film and all the capacitors ceramic disc type. A suitable type of diode D1 and D2 is the Siemens SFH 2030; the Zener diodes D3 and D4 may be 6V2 Zener. The

variable resistors VR1 and VR2 should be 10K preset; all other resistor values are as stated in Figure 5. The power supply should be +/- 12V. The LED LD1 should preferably be a rectangular diffused red type.

The design of the circuit for the present invention, as hereinbefore described, has a variety of important features which ensure the maintained accuracy of the operation of the present invention. In particular, the reference and adjustment voltages are all derived from the same supply rail; as a result supply voltage variations will tend to cancel out. Similarly, the sensing and compensating photodiodes D1 and D2 are both of the same type. Any external factors, for example temperature or aging, which may influence the performance of the components have the same effect on both the compensating and sensing photodiodes D1 and D2. Consequently, any variations in external factors do not influence the overall performance of the present invention. The casing for the present invention may further include an opaque enclosure to compensate or exclude the effects of extraneous light on the operation of the present invention. A further embodiment of the present invention may include a rotary bearing on which the photo resistant interruptor 2 is mounted. The photo resistant interruptor 2 would then typically have a radius which increases in size relative to the position of the LED LD1 and the sensing photodiode D1. The internal components of the present invention could, furthermore, have a matt finish to reduce the reflection of light within the apparatus.

The optical potentiometer may typically be used for cross fading. In this application, the outputs from the operational amplifiers U2C and U2D may typically both be connected to two sections of an Analog Devices quad Voltage-Controlled Amplifier chip (not shown) which does the cross fading. The signal processing means firstly convert the photo current from photodiode U2A to a

proportional voltage, by means of a well known transimpedance amplifier. The compliment of this voltage is then derived by means of an inverting amplifier U2B. Two similar non-linear amplifiers, U2C and U2D, distort said proportional voltage and its complement to achieve the desired relationship between knob position and audio volume. The outputs from said non-linear amplifiers control voltage-controlled amplifiers (VCAs). Where there the optical potentiometer is used as a cross-fader for two stereo audio signals, four VCAs may be used in total. The VCA chip used has a linear control law, and although an exponential law would be considered more suitable, in practice it seems to work satisfactorily.

Viewed from another broad aspect the present invention provides an optical potentiometer comprising an armature, support means, and one or more rotary or linear bearings upon which the armature may translate or rotate relative to the support means, also comprising light emitting and light detecting means, both of said means being attached to the support means and arranged such that the light from the light emitting means falls upon the light detecting means, also means by which the motion of the armature regulates the amount of light from the light emitting means which falls on the light detecting means in a progressive manner, also means to exclude extraneous light.

CLAIMS

1. An optical potentiometer comprising a light source, a light detecting means, a linearly movable control member, and light blocking means disposed between the light source and light detecting means which is movable to selectively determine the amount of light from the source which is received by the light detecting means, the position of the light blocking means being controlled by the linearly movable control member, characterised in that the light blocking means moves transversely with respect to the path of light from the light source to the light detecting means and has an operative edge which is profiled to adjust the amount of light passing from the light source to the light detecting means in accordance with the transverse position of the light blocking means.

2. An optical potentiometer as claimed in claim 1, characterised in that the light blocking means is in the form of a plate having an aperture which defines the operative edge.

3. An optical potentiometer as claimed in claim 1, characterised in that the light blocking means is in the form of a plate having a free edge defining the operative edge.

4. An optical potentiometer as claimed in claim 3, characterised in that the operative edge is inclined in the direction of movement of the light blocking means.

5. An optical potentiometer as claimed in claim 4, characterised in that it comprises a base, a longitudinally extending support provided on the base, a slider mounted on the support for longitudinal movement, and a control member on an outer lateral edge of the

slider, the inner lateral edge of the slider being opaque and tapering in the longitudinal direction so as to define the light blocking means and operative edge, the light source being disposed on one side of the slider adjacent the inner lateral edge and the light detecting means being aligned with the light source and on the other side of the slider.

6. An optical potentiometer as claimed in claim 5, characterised in that the light source, light detecting means and light blocking means are within a light proof housing.

7. An optical potentiometer as claimed in claim 5, characterised in that the light source is a light emitting diode.

8. An optical potentiometer as claimed in claim 1, characterised in that there is provided second light detecting means arranged to detect light from the light source without the intervention of the light blocking means, and compensating means which maintains the output of the light source substantially stable in accordance with a signal provided by the second light detecting means.

9. An optical potentiometer as claimed in claim 8, characterised in that the compensating means adjusts the output by means of negative feedback.

10. An optical potentiometer as claimed in claim 9, characterised in that the second light detecting means is substantially identical to the first light detecting means.

11. An optical potentiometer comprising a base, a longitudinally extending support provided on the base, a

slider mounted on the support for longitudinal movement, a control member on an outer lateral edge of the slider, the inner lateral edge of the slider being opaque and tapering in the longitudinal direction, a light source on one side of the slider adjacent the inner lateral edge, and light detecting means aligned with the light source and on the other side of the slider, so that longitudinal movement of the slider under the action of the control member selectively controls the amount of light reaching the light detecting means from the light source.

12. An optical potentiometer as claimed in claim 11, characterised in that second light detecting means is positioned on said one side of the slider to receive light from the light source without the intervention of the slider, and in that compensating means are provided to control the output of the light source in accordance with a signal from the second light detecting means.

13. An optical potentiometer comprising a light source, first light detecting means, a movable control member, and light blocking means disposed between the light source and the first light detecting means which selectively determines the amount of light from the source which is received by the first light detecting means in accordance with the position of the movable control member, characterised in that there is provided second light detecting means arranged to detect light from the light source without the intervention of the light blocking means, and compensating means which maintains the output of the light source substantially stable in accordance with a signal provided by the second light detecting means.

14. An optical potentiometer comprising an armature, support means, and one or more rotary or linear bearings

upon which the armature may translate or rotate relative to the support means, also comprising light emitting and light detecting means, both of said means being attached to the support means and arranged such that the light from the light emitting means falls upon the light detecting means, also means by which the motion of the armature regulates the amount of light from the light emitting means which falls on the light detecting means in a progressive manner, also means to exclude extraneous light.

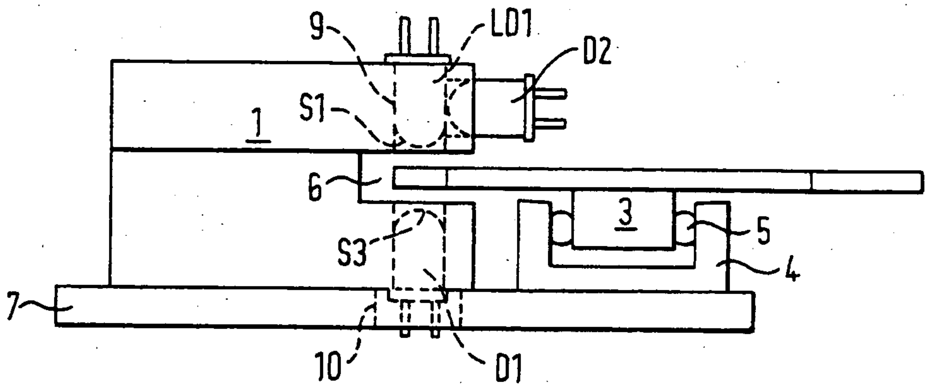


FIG. 1

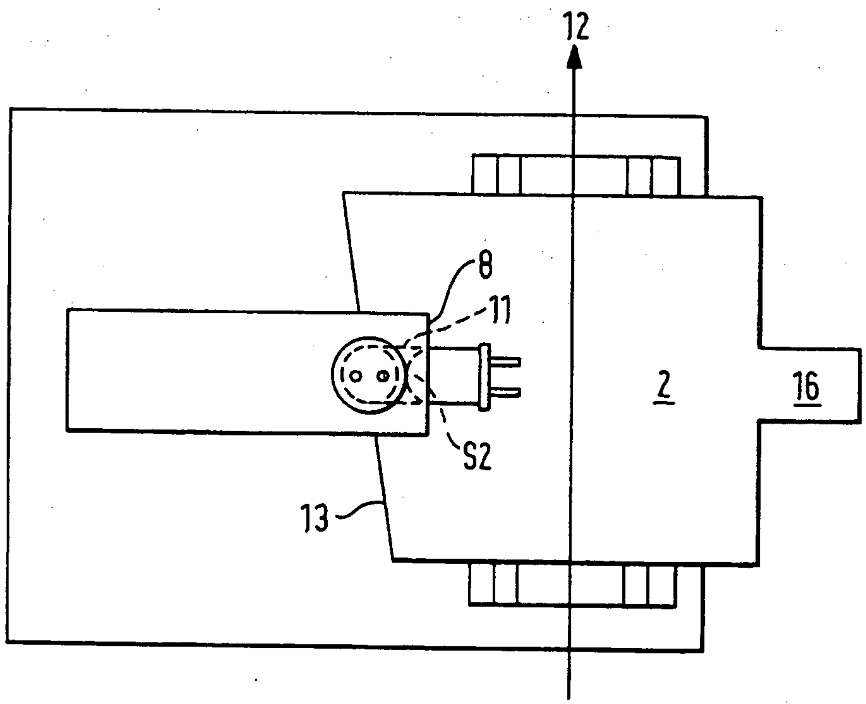
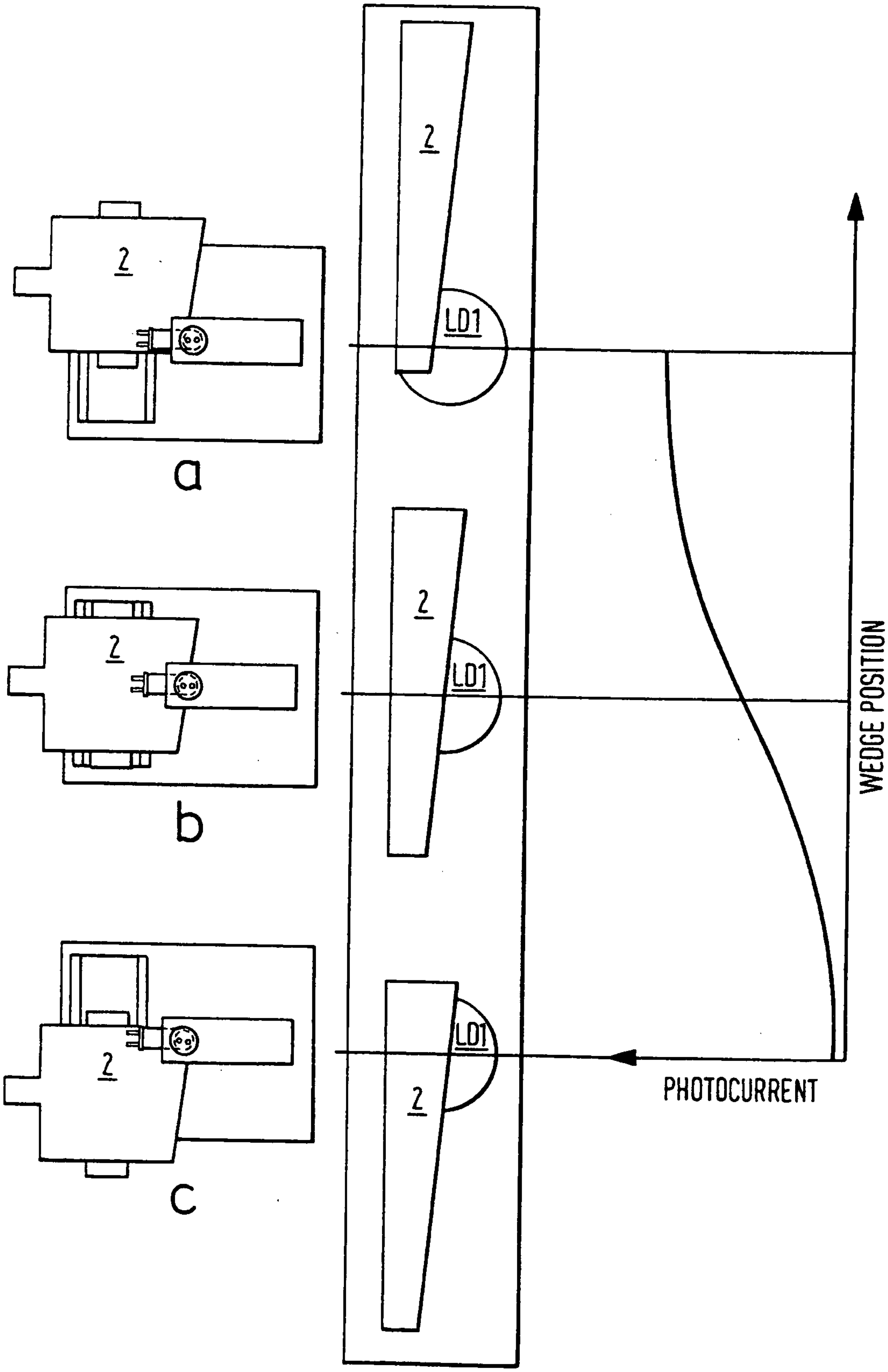


FIG. 2

FIG. 3



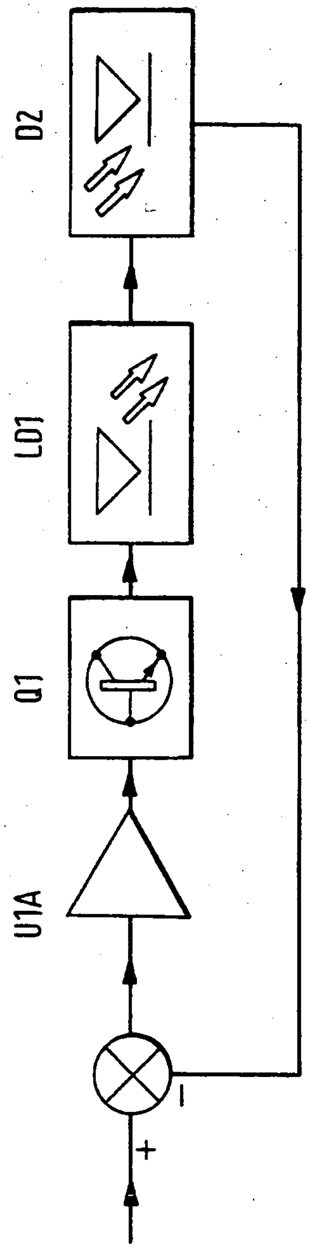
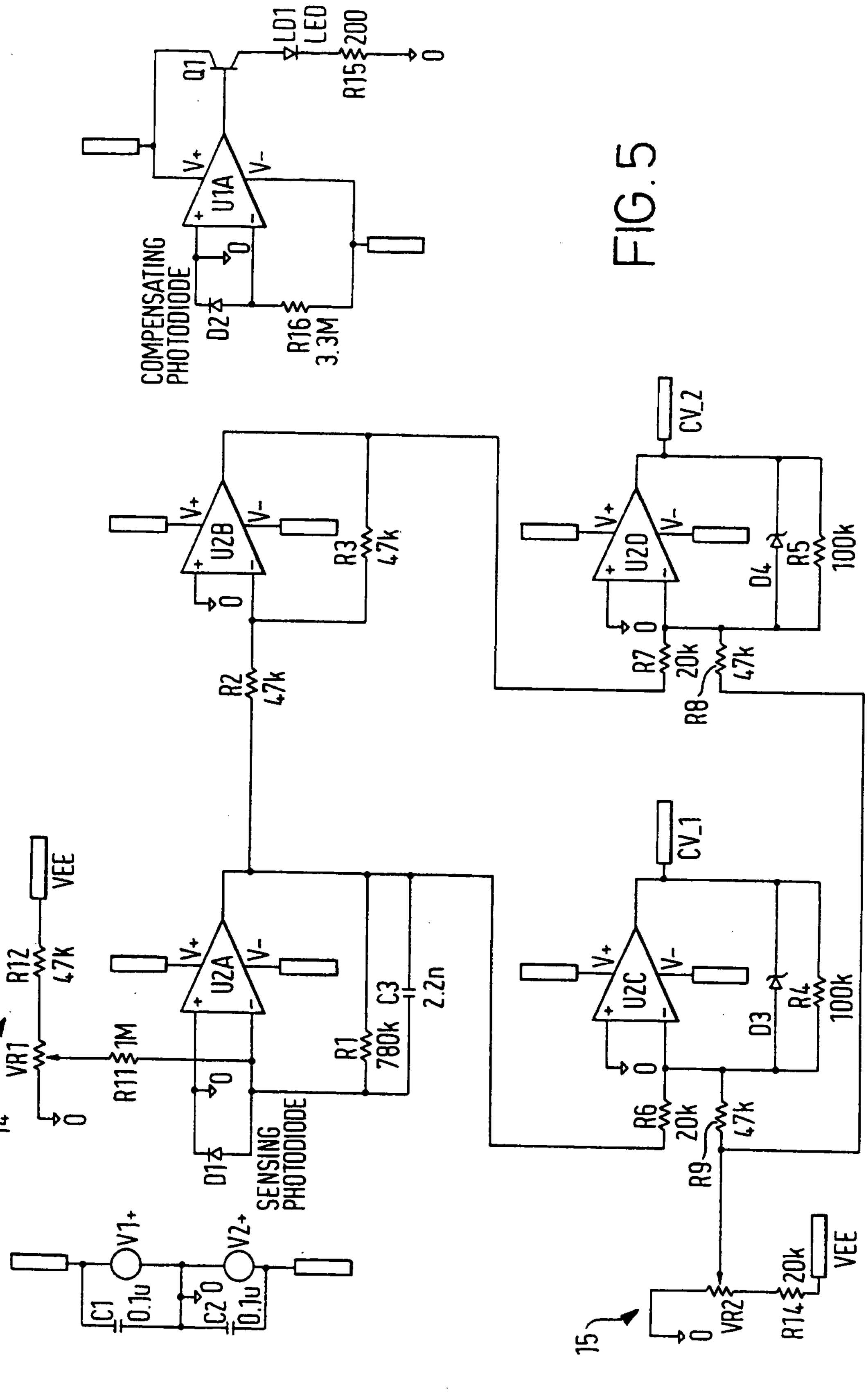


FIG. 4


LD1
LED
R15
200
Q1
V+
V-
U1A
COMPENSATING
PHOTODIODE
D2
R16
3.3M
U2B
R3
47k
R2
47k
CV_2
U2D
D4
R5
100k
R7
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47k
R8
VEE
R12
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VR1
14
R11
1M
U2A
R1
780k
C3
2.2n
D1
SENSING
PHOTODIODE
CV_1
U2C
D3
R4
100k
R6
20k
47k
R9
V1+
V2+
C1
0.1u
C2
0.1u
VR2
R14
20k
15

FIG. 5

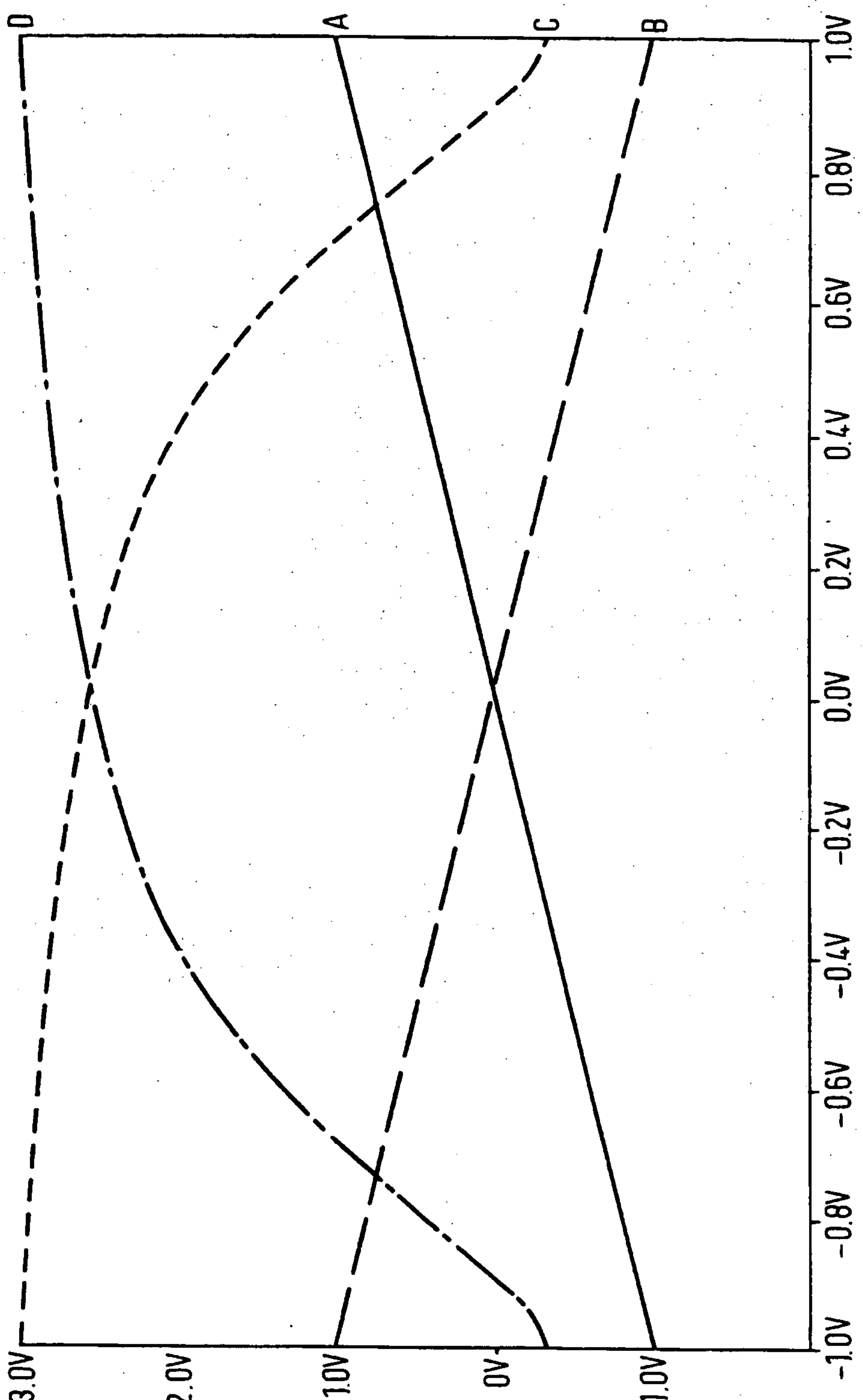
D
A
C
B
3.0V
2.0V
1.0V
0V
-1.0V
1.0V
0.8V
0.6V
0.4V
0.2V
0.0V
-0.2V
-0.4V
-0.6V
-0.8V
-1.0V

FIG. 6

INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 99/01725

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H01L31/16

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 H01L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 96 08042 A (BLOEMEN JOOST LODEWIJK KAREL F) 14 March 1996 (1996-03-14) the whole document	14
A	WO 95 34082 A (SANTHA ANDRAS) 14 December 1995 (1995-12-14) claims 1-5; figure 2	1-7,11
A	EP 0 005 548 A (HEIMANN GMBH) 28 November 1979 (1979-11-28) page 9, line 17 - line 32; figure 7	1
A	US 5 285 085 A (ONISHI MINORU) 8 February 1994 (1994-02-08) column 7, line 55 - column 8, line 48; figure 5	1,2

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
6 September 1999	14/09/1999

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Acco, S

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
A	PATENT ABSTRACTS OF JAPAN vol. 011, no. 129 (P-570), 23 April 1987 (1987-04-23) & JP 61 271414 A (MITSUBISHI ELECTRIC CORP), 1 December 1986 (1986-12-01) abstract	1,8-10

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

national Application No
PCT/GB 99/01725

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
WO 9608042	A	14-03-1996	NL	9401441 A	01-04-1996
WO 9534082	A	14-12-1995	AU	7081694 A	04-01-1996
EP 0005548	A	28-11-1979	DE	2822502 A	29-11-1979
			JP	54153267 A	03-12-1979
			US	4283702 A	11-08-1981
US 5285085	A	08-02-1994	NONE		
JP 61271414	A	01-12-1986	NONE		